

WHAT IS CLAIMED IS:

1. A bipolar transistor, comprising:
  - a semiconductor substrate;
  - 5 a transistor operation region formed on the semiconductor substrate;
  - an insulating film formed so as to cover a surface of the semiconductor substrate;
  - a lead line led to a surface of the insulating film therethrough from the transistor operation region;
  - 10 a pad for wire bonding connected to the lead line; and
  - a capacitance adjustment line connected to the pad.
2. The bipolar transistor according to claim 1, wherein the semiconductor substrate is an N<sup>+</sup>/N type collector substrate, a collector electrode is formed on a reverse surface of the collector substrate, and the pad is formed on a surface of the collector substrate as an emitter pad and a base pad.
- 15 3. The bipolar transistor according to claim 2, wherein by adjusting an area of the capacitance adjustment line connected to at least one of the base pad and the emitter pad, at least one capacitance value of a corresponding collector-base capacitor and collector-emitter capacitor is adjusted.
- 20 4. The bipolar transistor according to claim 2, wherein by adjusting lengths of lines opposed to each other of the capacitance adjustment line connected to the emitter pad and the capacitance adjustment line connected to the base pad, a capacitance value of an emitter-base capacitor is adjusted.
- 25 5. The bipolar transistor according to claim 4, wherein the capacitance adjustment line connected to the emitter pad and the capacitance adjustment line connected to the base pad are disposed in a comb shape.
- 30 6. The bipolar transistor according to claim 1, wherein the semiconductor substrate is an N<sup>+</sup>/N type emitter substrate, an emitter electrode is formed on a reverse surface of the emitter substrate, and the pad is formed on a surface of the emitter substrate as a collector pad and a base pad.
- 35 7. The bipolar transistor according to claim 6, wherein the capacitance

adjustment line connected to the collector pad and the capacitance adjustment line connected to the base pad, which is opposed to the capacitance adjustment line connected to the collector pad, interpose the insulating film therebetween to form a collector-base capacitor as a

5 Metal-Insulator-Metal (MIM) type capacitor, and by adjusting an opposed area of the capacitance adjustment lines, a capacitance value of the collector-base capacitor is adjusted.

8. An oscillation circuit using a bipolar transistor as an oscillation amplifier,

10 the bipolar transistor comprising:

- a semiconductor substrate;
- a transistor operation region formed on the semiconductor substrate;
- an insulating film formed so as to cover a surface of the semiconductor substrate;

15 a lead line led to a surface of the insulating film therethrough from the transistor operation region;

- a pad for wire bonding connected to the lead line; and
- a capacitance adjustment line connected to the pad,

20 wherein the semiconductor substrate is an N<sup>+</sup>/N type collector substrate, a collector electrode is formed on a reverse surface of the collector substrate, the pad is formed on a surface of the collector substrate as an emitter pad and a base pad, by adjusting an area of the capacitance adjustment line connected to at least one of the base pad and the emitter pad, a capacitance value of at least one of a corresponding collector-base capacitor

25 and collector-emitter capacitor is adjusted, and

- at least a part of a capacitor contributing to an oscillation operation is composed of a parasitic capacitor formed between the capacitance adjustment line and the collector electrode opposed thereto.

30 9. An oscillation circuit using a bipolar transistor as an oscillation amplifier

35 the bipolar transistor comprising:

- a semiconductor substrate;
- a transistor operation region formed on the semiconductor substrate;
- an insulating film formed so as to cover a surface of the semiconductor substrate;

35 a lead line led to a surface of the insulating film therethrough from the transistor operation region;

a pad for wire bonding connected to the lead line; and  
a capacitance adjustment line connected to the pad,  
wherein the semiconductor substrate is an N<sup>+</sup>/N type collector  
substrate, a collector electrode is formed on a reverse surface of the collector  
5 substrate, the pad is formed on a surface of the collector substrate as an  
emitter pad and a base pad, by adjusting lengths of lines opposed to each  
other of the capacitance adjustment line connected to the emitter pad and the  
capacitance adjustment line connected to the base pad, a capacitance value of  
emitter-base capacitance is adjusted, and  
10 at least a part of a capacitor contributing to an oscillation operation is  
composed of a parasitic capacitor formed between the capacitance adjustment  
line connected to the emitter pad and the capacitance adjustment line  
connected to the base pad.

15 10. The oscillation circuit according to claim 9, wherein the capacitance  
adjustment line connected to the emitter pad of the bipolar transistor and the  
capacitance adjustment line connected to the base pad of the bipolar  
transistor are disposed in a comb shape.

20 11. An oscillation circuit using a bipolar transistor as an oscillation amplifier,  
the bipolar transistor comprising:  
a semiconductor substrate;  
a transistor operation region formed on the semiconductor substrate;  
an insulating film formed so as to cover a surface of the  
25 semiconductor substrate;  
a lead line led to a surface of the insulating film therethrough from  
the transistor operation region;  
a pad for wire bonding connected to the lead line; and  
a capacitance adjustment line connected to the pad,  
30 wherein the semiconductor substrate is an N<sup>+</sup>/N type emitter  
substrate, an emitter electrode is formed on a reverse surface of the emitter  
substrate, the pad is formed on a surface of the emitter substrate as a  
collector pad and a base pad, the capacitance adjustment line connected to  
the collector pad and the capacitance adjustment line connected to the base  
35 pad, which is opposed to the capacitance adjustment line connected to the  
collector pad, interpose the insulating film therebetween to form a  
collector-base capacitor as a Metal-Insulator-Metal (MIM) type capacitor,

and by adjusting an opposed area of the capacitance adjustment lines, a capacitance value of the collector-base capacitance is adjusted, and at least a part of a capacitor contributing to an oscillation operation is composed of the MIM type capacitor.

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12. A voltage controlled oscillator, comprising:

a resonance circuit for varying a value of a resonance frequency in accordance with an input voltage;

10 an oscillation circuit for oscillating a signal with a frequency in accordance with the resonance frequency, using a bipolar transistor as an oscillation amplifier; and

a buffer circuit for amplifying and outputting the oscillation signal from the oscillation circuit,

15 the bipolar transistor constituting the oscillation circuit comprising:

a semiconductor substrate;

a transistor operation region formed on the semiconductor substrate;

20 an insulating film formed so as to cover a surface of the semiconductor substrate;

a lead line led to a surface of the insulating film therethrough from

25 the transistor operation region;

a pad for wire bonding connected to the lead line; and

30 a capacitance adjustment line connected to the pad,

wherein the semiconductor substrate is an N<sup>+</sup>/N type collector substrate, a collector electrode is formed on a reverse surface of the collector substrate, the pad is formed on a surface of the collector substrate as an emitter pad and a base pad, by adjusting an area of the capacitance adjustment line connected to at least one of the base pad and the emitter pad, a capacitance value of at least one of a corresponding collector-base capacitor and collector-emitter capacitor is adjusted, and

35 at least a part of a capacitor contributing to an oscillation operation is composed of a parasitic capacitor formed between the capacitance adjustment line and the collector electrode opposed thereto.

13. A voltage controlled oscillator, comprising:

35 a resonance circuit for varying a value of a resonance frequency in accordance with an input voltage;

an oscillation circuit for oscillating a signal with a frequency in

accordance with the resonance frequency, using a bipolar transistor as an oscillation amplifier; and

a buffer circuit for amplifying and outputting the oscillation signal from the oscillation circuit,

5        the bipolar transistor constituting the oscillation circuit comprising:  
a semiconductor substrate;  
a transistor operation region formed on the semiconductor substrate;  
an insulating film formed so as to cover a surface of the semiconductor substrate;

10      a lead line led to a surface of the insulating film therethrough from the transistor operation region;

      a pad for wire bonding connected to the lead line; and

      a capacitance adjustment line connected to the pad,

      wherein the semiconductor substrate is an N<sup>+</sup>/N type collector

15      substrate, a collector electrode is formed on a reverse surface of the collector substrate, the pad is formed on a surface of the collector substrate as an emitter pad and a base pad, by adjusting lengths of lines opposed to each other of the capacitance adjustment line connected to the emitter pad and the capacitance adjustment line connected to the base pad, a capacitance value of  
20      an emitter-base capacitor is adjusted, and

      at least a part of a capacitor contributing to an oscillation operation is composed of a parasitic capacitor formed between the capacitance adjustment line connected to the emitter pad and the capacitance adjustment line connected to the base pad.

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14. The voltage controlled oscillator according to claim 13, wherein the capacitance adjustment line connected to the emitter pad of the bipolar transistor and the capacitance adjustment line connected to the base pad of the bipolar transistor are disposed in a comb shape.

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15. A voltage controlled oscillator, comprising:

      a resonance circuit for varying a value of a resonance frequency in accordance with an input voltage;

35      an oscillation circuit for oscillating a signal with a frequency in accordance with the resonance frequency, using a bipolar transistor as an oscillation amplifier; and

      a buffer circuit for amplifying and outputting the oscillation signal

from the oscillation circuit,

- the bipolar transistor constituting the oscillation circuit comprising:
  - a semiconductor substrate;
  - a transistor operation region formed on the semiconductor substrate;
  - 5 an insulating film formed so as to cover a surface of the semiconductor substrate;
  - a lead line led to a surface of the insulating film therethrough from the transistor operation region;
  - 10 a pad for wire bonding connected to the lead line; and
  - a capacitance adjustment line connected to the pad,
- 15 wherein the semiconductor substrate is an N<sup>+</sup>/N type emitter substrate, an emitter electrode is formed on a reverse surface of the emitter substrate, the pad is formed on a surface of the emitter substrate as a collector pad and a base pad, the capacitance adjustment line connected to the collector pad and the capacitance adjustment line connected to the base pad, which is opposed to the capacitance adjustment line connected to the collector pad, interpose the insulating film therebetween to form a collector-base capacitor as a metal-insulator-metal (MIM) type capacitor, and by adjusting an opposed area of the capacitance adjustment lines, a
- 20 capacitance value of the collector-base capacitor is adjusted, and
  - at least a part of a capacitor contributing to an oscillation operation is composed of the MIM type capacitor.